WHAT IS CLAIMED IS:

1. A semiconductor device, comprising:

a first-conductivity type semiconductor substrate;

an insulating film formed on said semiconductor substrate;

a gate electrode formed on said semiconductor substrate via said insulating film; and

a second-conductivity type source/drain region formed on both sides of a channel forming region located under said gate electrode formed on said semiconductor substrate via said insulating film; and

wherein a thickness of said insulating film is less than 2.5 nm at silicon oxide equivalent thickness; and a gate length of said gate electrode is equal to or less than 0.3 μm.

2. The semiconductor device, wherein the semiconductor device as defined in claim 1 is included as a part of a semiconductor device.

3. The semiconductor device of claim 1, wherein when the semiconductor device is in operation, direct-tunneling leakage current flows through said insulating film.

4. The semiconductor device of claim 1, wherein the thickness of said insulating film is less than 2.5 nm.

5. A semiconductor device, comprising:

a first-conductivity type semiconductor substrate;

an insulating film formed on said semiconductor substrate;

a gate electrode formed on said semiconductor substrate via said insulating film; and

a second-conductivity type source/drain region formed on both sides of a channel forming region located under said gate electrode formed on said semiconductor substrate via said insulating film; and

wherein a channel direction length (L_g) of said gate electrode and a thickness (T_{ox}) of said gate insulating film satisfy the following relationship:

$L_g \leq 10 (T_{ox} - 2.02)$

where a unit of L_g is μm and a unit of T_{ox} is nm.

6. A semiconductor device, comprising:

a first-conductivity type semiconductor substrate;

an insulating film formed on said semiconductor substrate;

a gate electrode formed on said semiconductor substrate via said insulating film; and

a second-conductivity type source/drain region formed on both sides of a channel forming region located under said gate electrode formed on said semiconductor substrate via said insulating film; and

wherein a thickness of said insulating film is less than 2.5 nm at silicon oxide equivalent thickness; a gate length of said gate electrode is equal to or less than 0.3 μm; and a voltage applied to said gate electrode and said drain region is determined to be 1.5 V or less.

7. The semiconductor device of claim 6, wherein a voltage applied to said gate electrode is determined to be 0.5 V or less.

8. The semiconductor device, wherein the semiconductor device as defined in claim 6 is included as a part of a semiconductor device.

9. The semiconductor device of claim 6, wherein when the semiconductor device is in operation, tunneling current flows through said insulating film.

10. The semiconductor device of claim 6, wherein the thickness said insulating film is less than 2.5 nm.

11. A semiconductor device, comprising:

a first-conductivity type semiconductor substrate;

an insulating film formed on said semiconductor substrate;

a gate electrode formed on said semiconductor substrate via said insulating film; and

a second-conductivity type source/drain region formed on both sides of a channel forming region located under said gate electrode formed on said semiconductor substrate via said insulating film; and

wherein a transconductance (gm) is as follows:

$gm > 400\ V_{DD} + 140$ in nMOS

$gm > 260\ V_{DD} + 10$ in pMOS

where a unit of V_{DD} is V and a unit of gm is mS/mm.

12. The semiconductor device of claim 11, wherein a voltage applied to said gate electrode and said drain region is determined to be 1.5 V or less.

13. The semiconductor device of claim 12, wherein a voltage applied to said gate electrode and said drain region is determined 0.5 V or less.

14. The semiconductor device of claim 11, wherein when the semiconductor device is in operation, direct-tunneling leakage current flows through said insulating film.

15. A semiconductor device, comprising:

a MOS FET including:

a first-conductivity type semiconductor substrate;

an insulating film formed on said semiconductor substrate and having a thickness less than 2.5 nm at silicon oxide equivalent thickness film;

a gate electrode formed on said semiconductor substrate via said insulating film; and

a second-conductivity type source/drain region formed on both sides of a channel forming region located under said gate electrode formed on said semiconductor substrate via said insulating film; and

a Schottky diode formed of a metal/silicon layer having a breakdown voltage lower than that of said insulating film and connected to said gate electrode of said MOSFET.

16. The semiconductor device of claim 15, wherein said Schottky diode is formed of a metal or an alloy having a main component selected from the group consisting of W, Ti, Mo, V, Ni, Co, and Al.

17. The semiconductor device of claim 15, wherein a voltage applied to said gate electrode is determined to be 0.5 V or less.

18. The semiconductor device, wherein the semiconductor device as defined in claim 15 is included as a part of a semiconductor device.

19. The semiconductor device of claim 15, wherein when the semiconductor device is in operation, direct-tunneling leakage current flows through said insulating film.

20. The semiconductor device of claim 15, wherein the thickness of said insulating film is less than 2.5 nm.